

FIG. 2

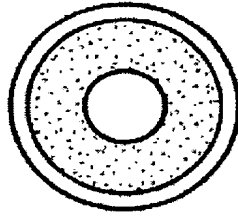


FIG. 3

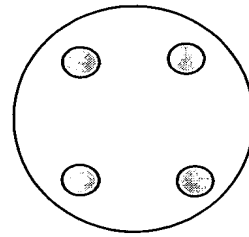


FIG. 4

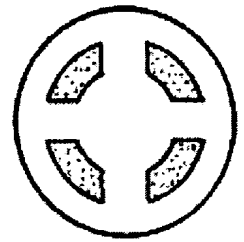


FIG. 5

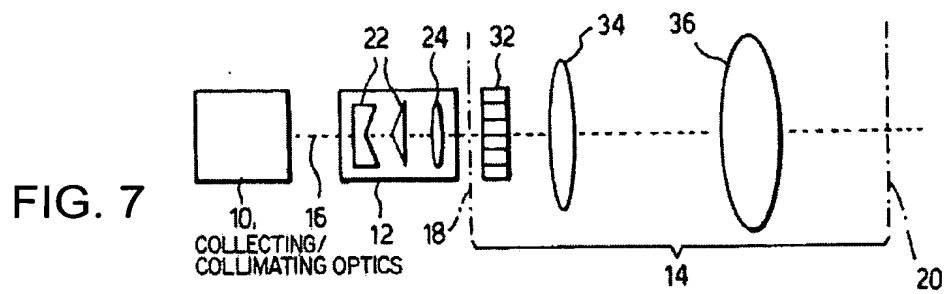
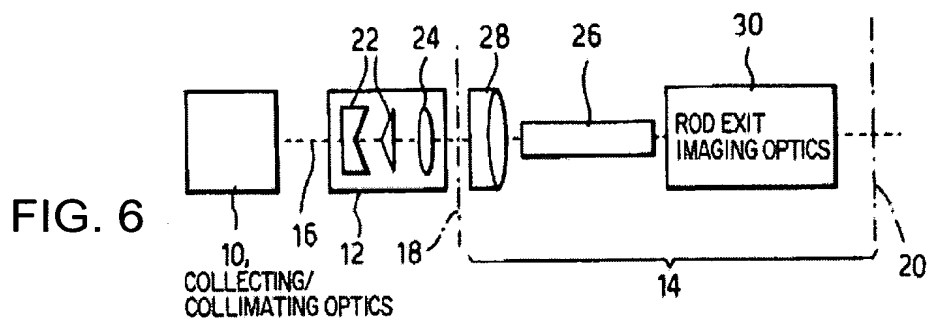


FIG. 8

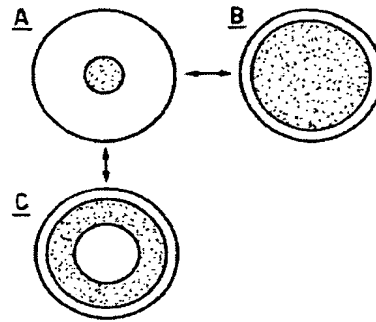
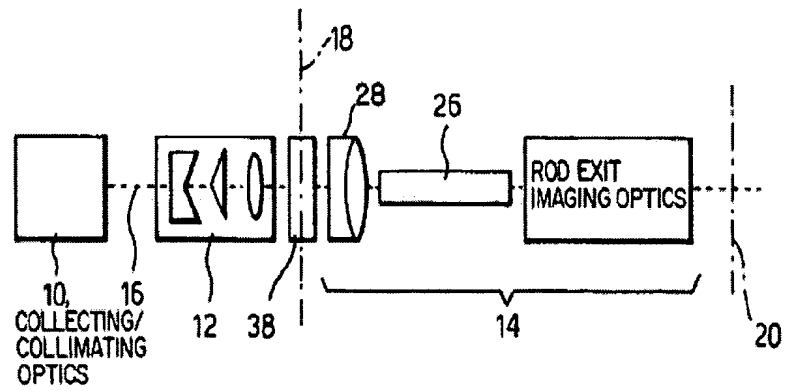


FIG. 9



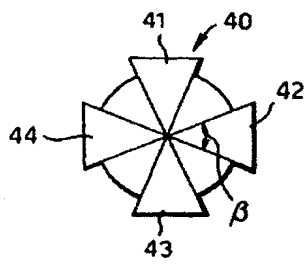


FIG. 10a

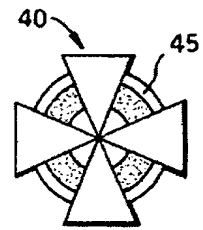


FIG. 10b

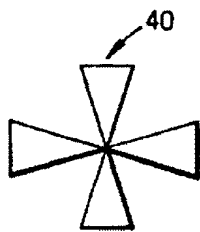


FIG. 11

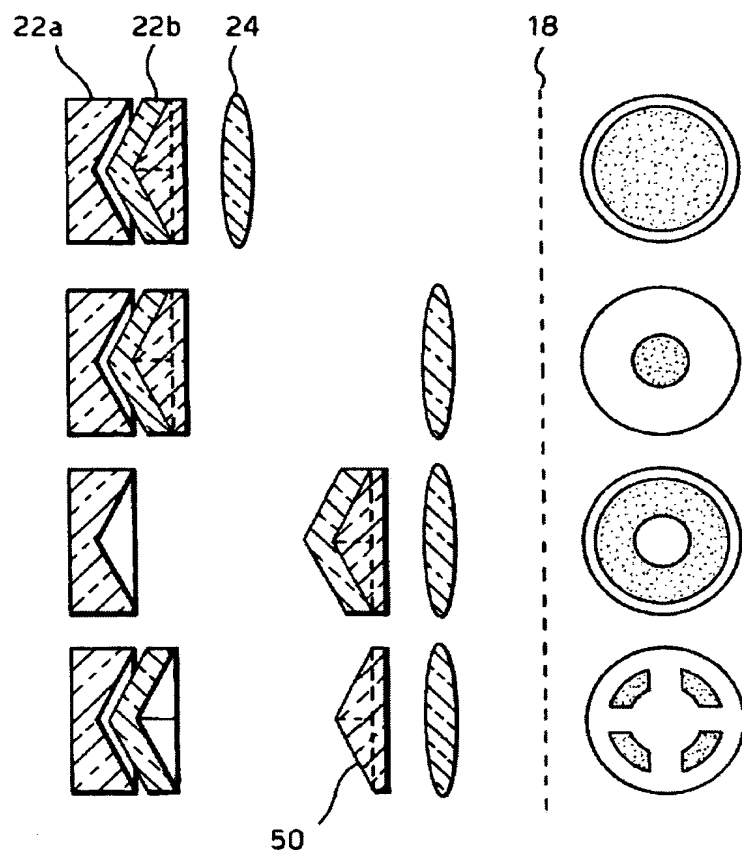


FIG. 12

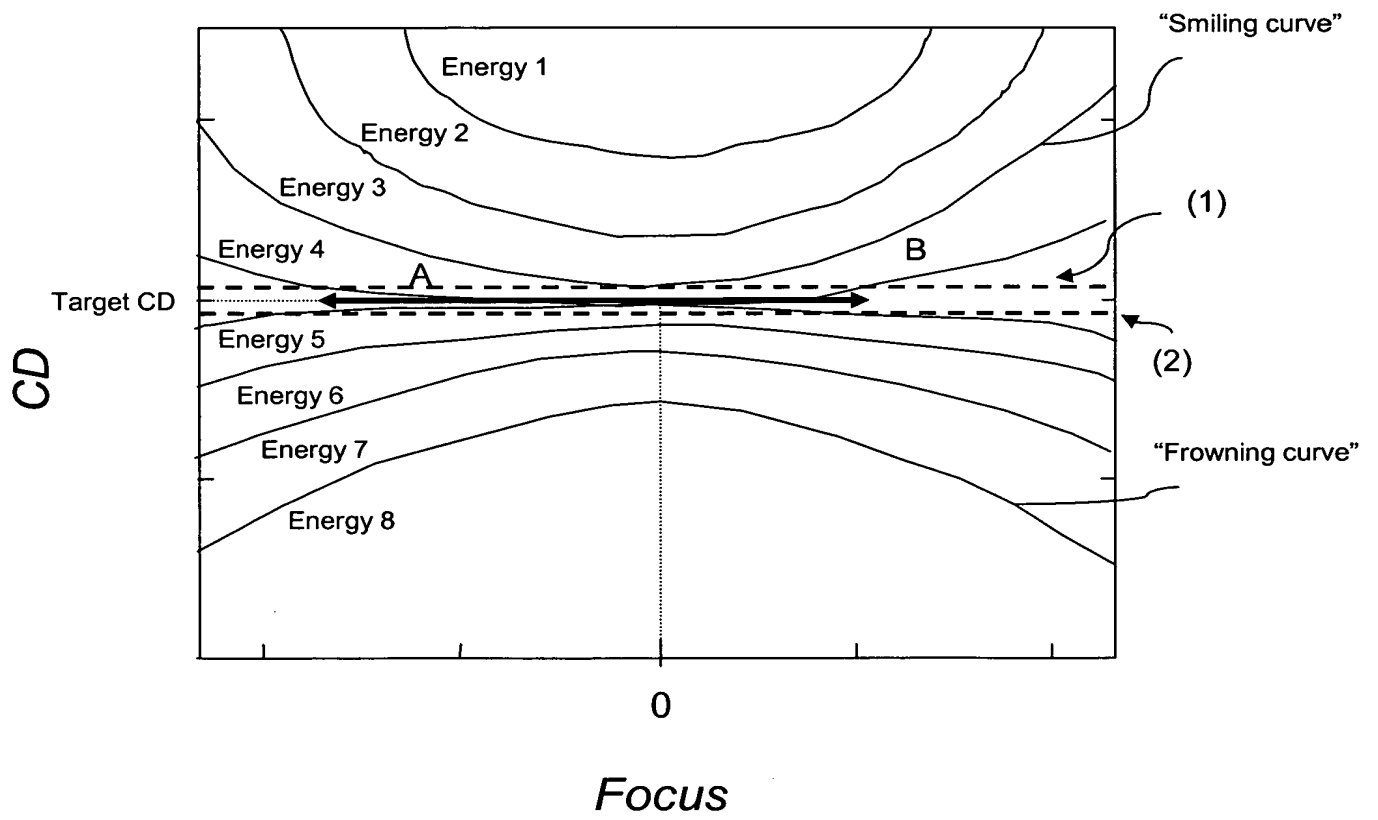


FIG. 13

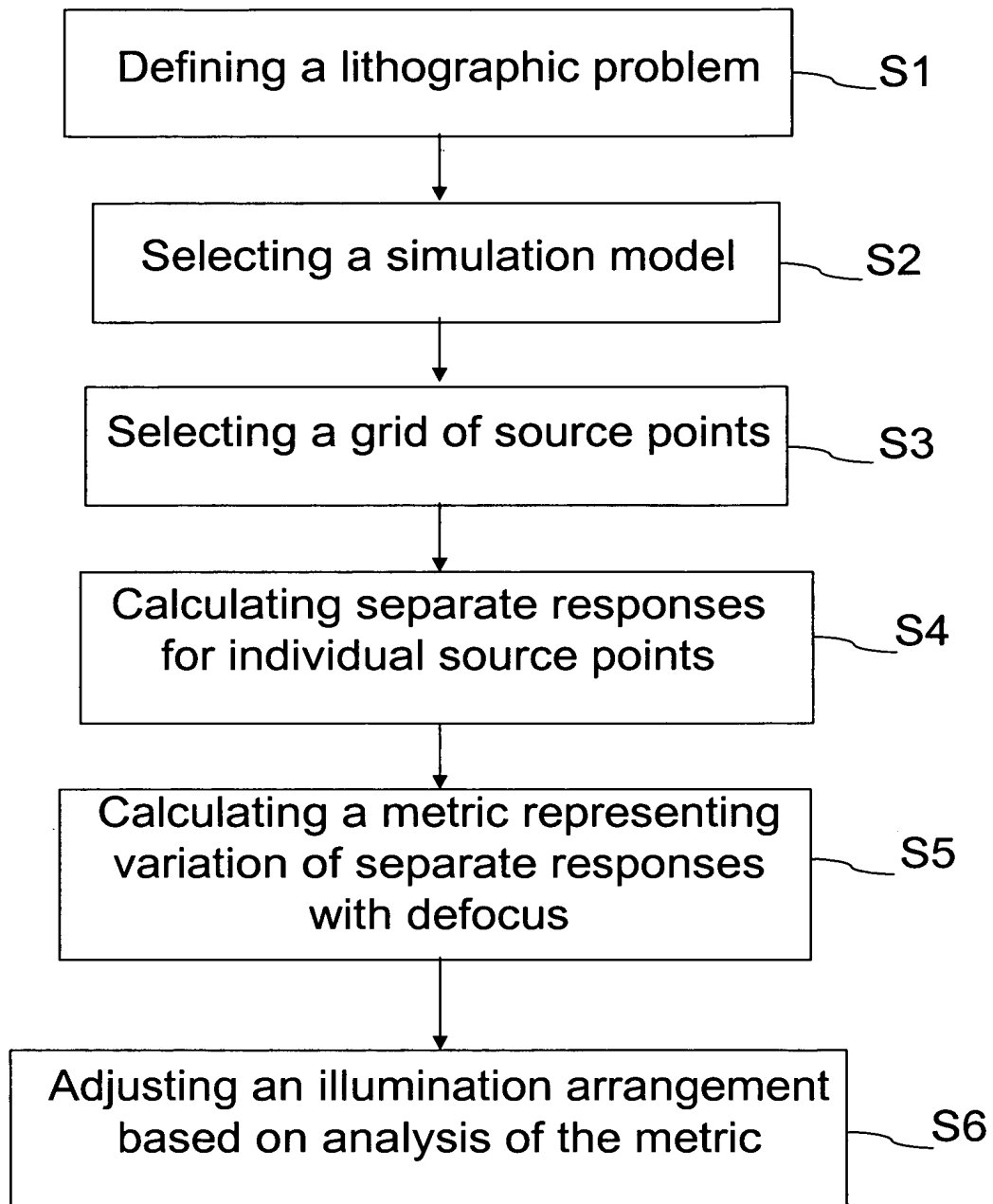


FIG. 14

resist calculation  $CD(BF+0.2)-CD(BF)$

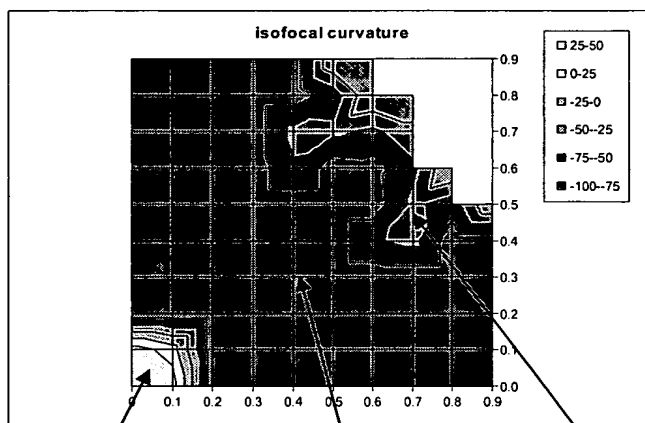
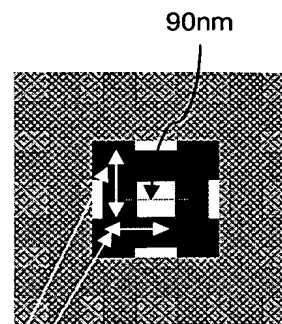


FIG. 15a



360nm

FIG. 15c

Area where  
Bossung  
"smiles"  
 $CD(=0.2) > C$   
 $D(f=0)$

Area where  
Bossung  
"frowns" severely  
hole closed at  
0.2u defocus

Area where  
Bossung  
"frowns"  
less  
severely

Aerial image calculation  $\text{thresh}(BF) - \text{thresh}(BF+0.2)$

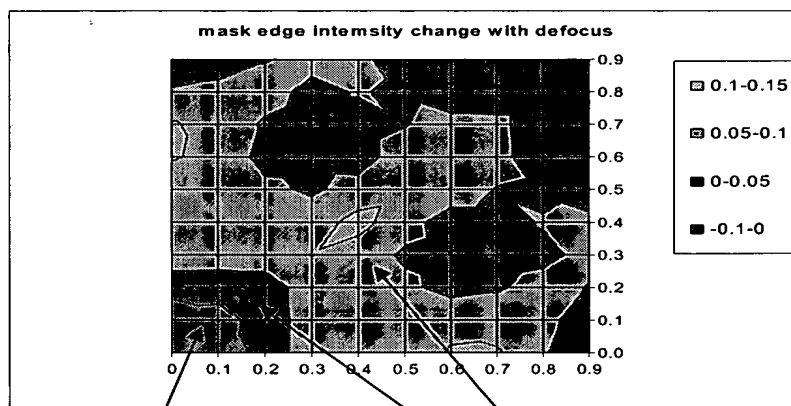


FIG. 15b

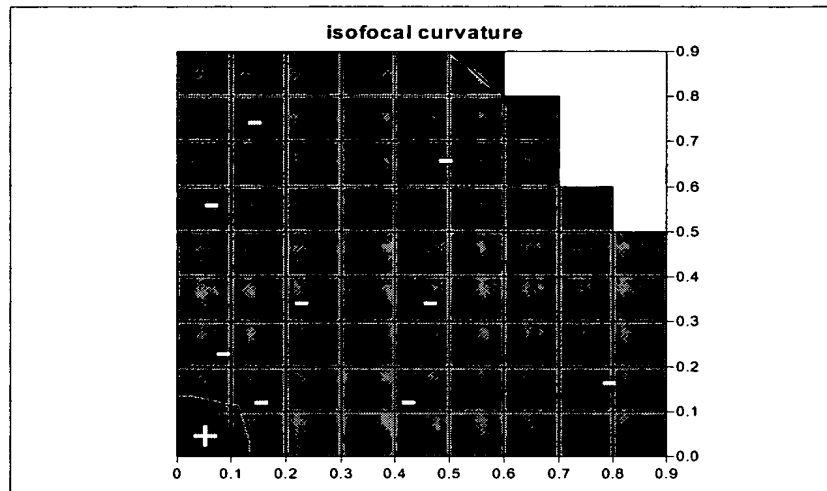
Area where  
image CD is  
larger in  
defocus

Area where  
image CD is  
smaller in  
defocus



resist calculation  $CD(BF+0.2)-CD(BF)$

FIG. 16a



Aerial image calculation  $\text{thresh}(BF)-\text{thresh}(BF+0.2)$

FIG. 16b

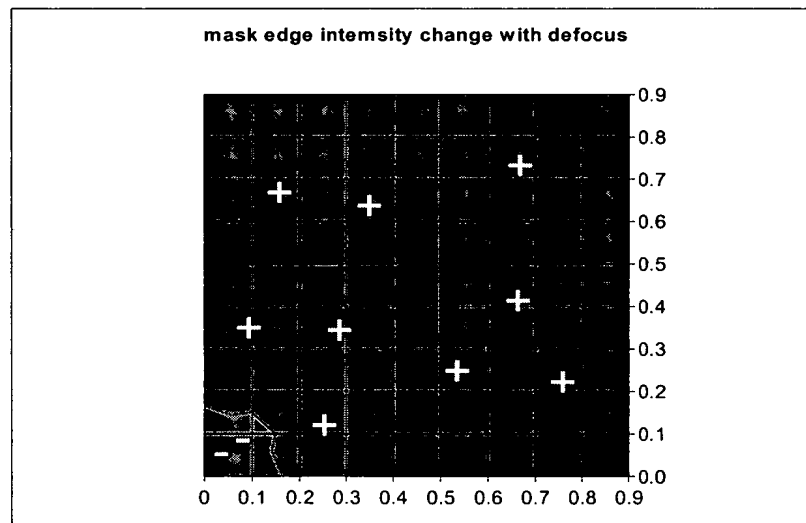
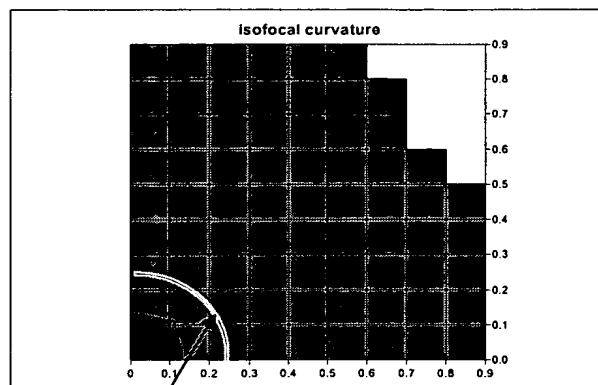


FIG. 17



$\sigma=0.25$  combines areas of + and - isofocal curvature

At  $\sigma=0.25$ , process is approximately isofocal. DOF is good but dose latitude is low.

FIG. 18

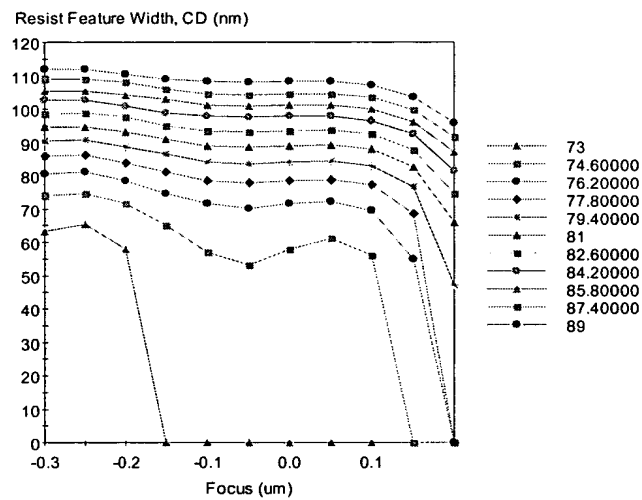
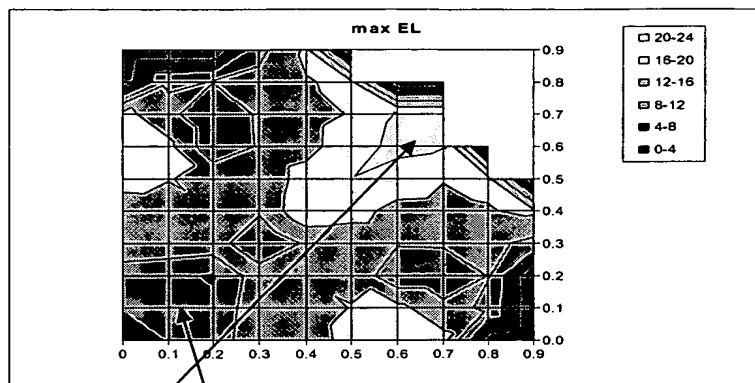


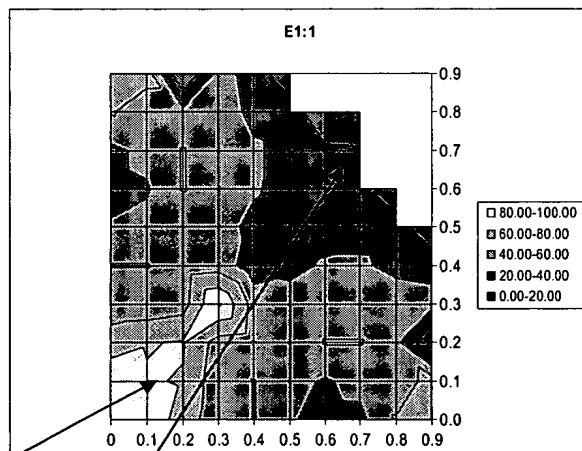
FIG. 19a



Low  $\sigma$  area provides poor EL and also requires high dose to print (weak aerial image)

Desirable area for high EL is wide quasar

FIG. 19b



Low  $\sigma$  area provides poor EL and also requires high dose to print (weak aerial image)

Wide quasar also provides low E1:1 (strong aerial image)

$$\text{Illuminator} = \sigma(0.1 \text{ conv}) + (0.92/0.88Q5^\circ)$$

FIG. 20

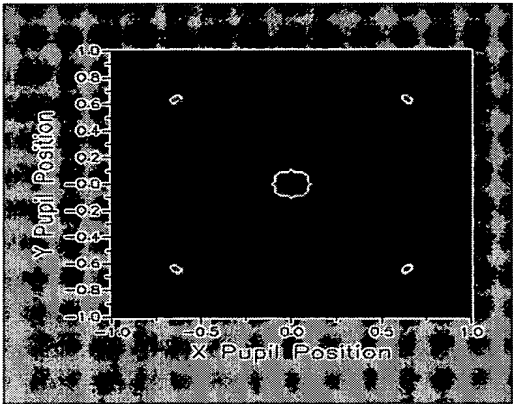


FIG. 21

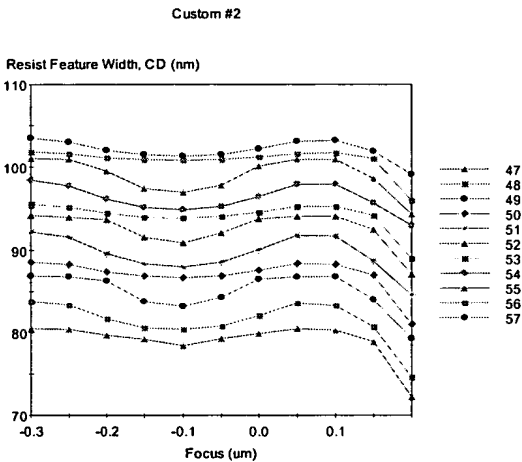
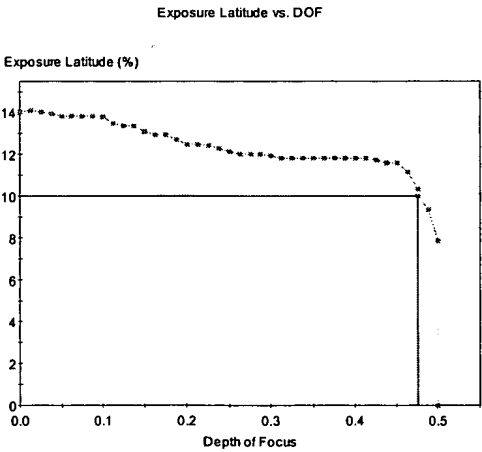


FIG. 22



optimization method	illumination	max EL	max DOF	DOF @ 10% EL	DOF @ 5% EL
standard	0.95/0.70Q30*	18%	0.3	0.18	0.24
simple isofocal compensation	0.25 conv	8%	>0.55	0	0.29
high EL isofocal compensation	0.92/0.88Q5*+0.1conv	16%	>0.65	0.57	0.63

FIG. 23

Large improvement in process window may be possible by appropriate use of illuminator to compensate isofocal curvature

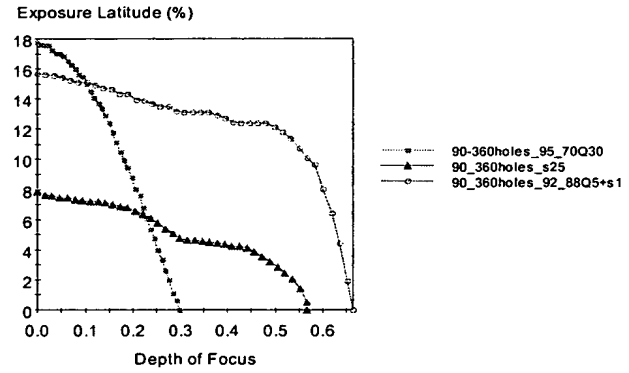


FIG. 24a

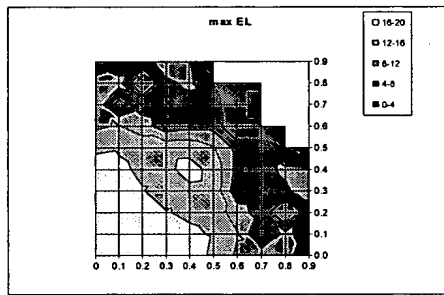


FIG. 24b

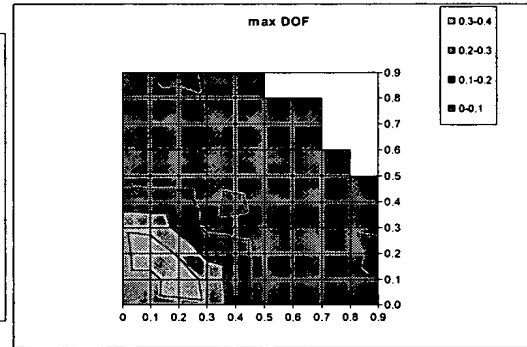


FIG. 24d

FIG. 24c

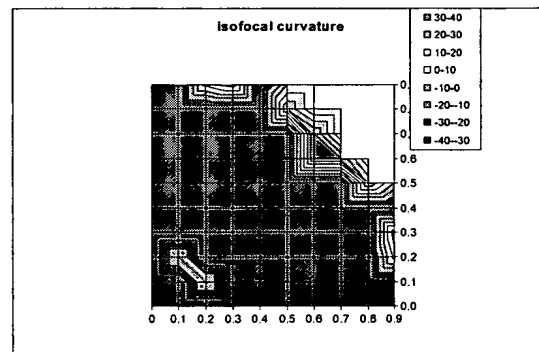
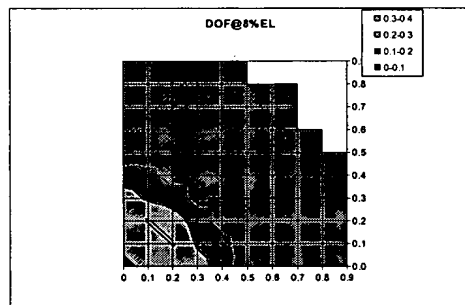


FIG. 25a

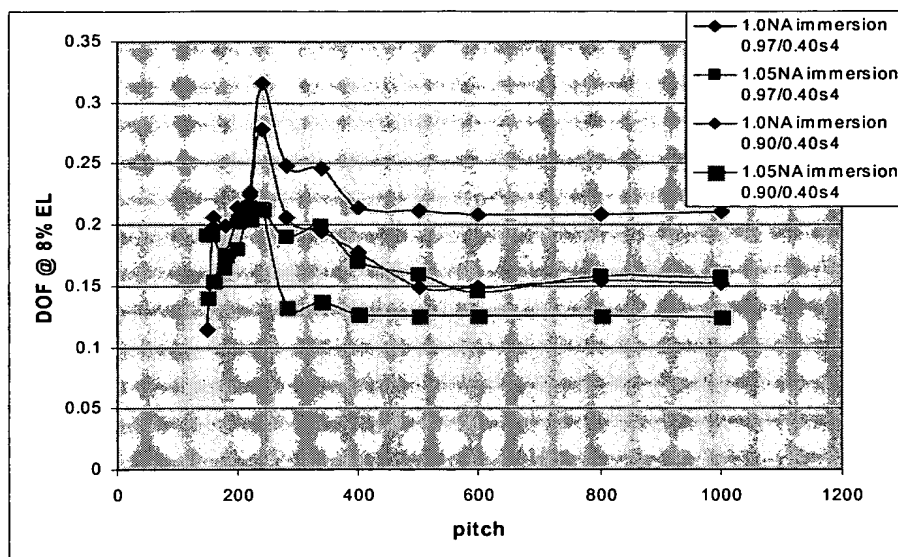
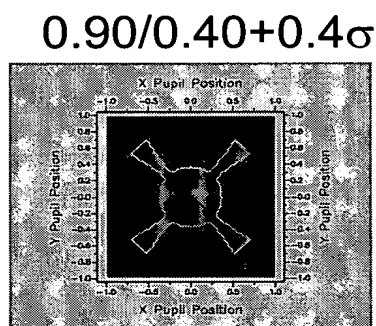


FIG. 25b



0.97/0.40+0.4 $\sigma$

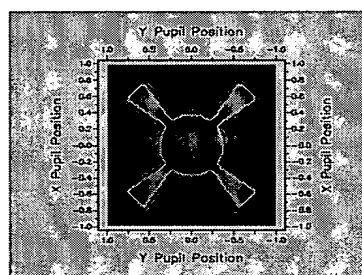


FIG. 25c